SENTIFIC SECTION
SECONDARY 2
MECHANICS

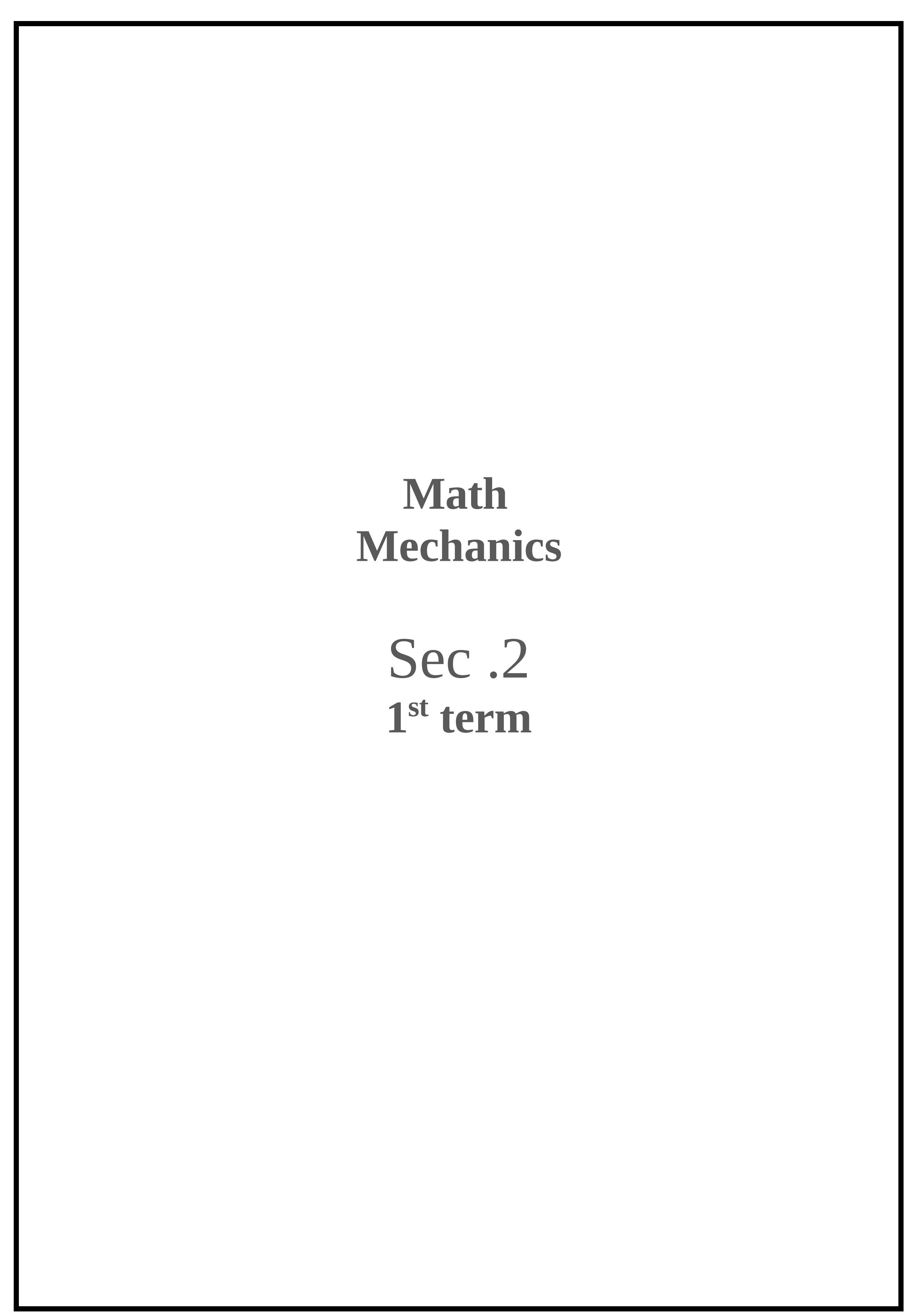


Geel 2000 Language Schools
Math Department
First Term

2024 / 2025

Name ……………………………………………………..

Class………………………………………………………..



Math
Mechanics

Sec .2
1st term

Complete the following:

The effect of a force on a body is determined by the following: ....

The vector of the resultant of the two forces F_1 , F_2 is equal to : ....

The maximum value of the resultant of two forces of magnitudes 4 , 6 Newton meeting at a point equals ....

The minimum value of the resultant of two forces of magnitudes 5 , 9 Newton meeting at a point equals ....

2 , 3 Newton are two forces , if the angle between them is 60 then the magnitude of their resultant equals

Choose the correct answer from those given:

The magnitude of the resultant of the two forces of magnitudes 3 , 5 newton and the measure of the angle between them is 60 equals

A 2 N   B 6 N   a 7 N   D 8 N

Two forces of magnitudes 3 , 4 N act on a particle and the magnitude of their resultant is 5 N , then the measure of the angle between them equals

A 30   B 45   a 60   D 90

Two equal forces, the magnitude of each of them is 6 N, the magnitude of their resultant is 6N , then the angle between them equals:

A 30   B 60   a 120   D 150

Two forces of magnitudes 3 , F Newton and the measure of the angle between them is 120. If their resultant is perpendicular to the first force, so the value of F in Newton is

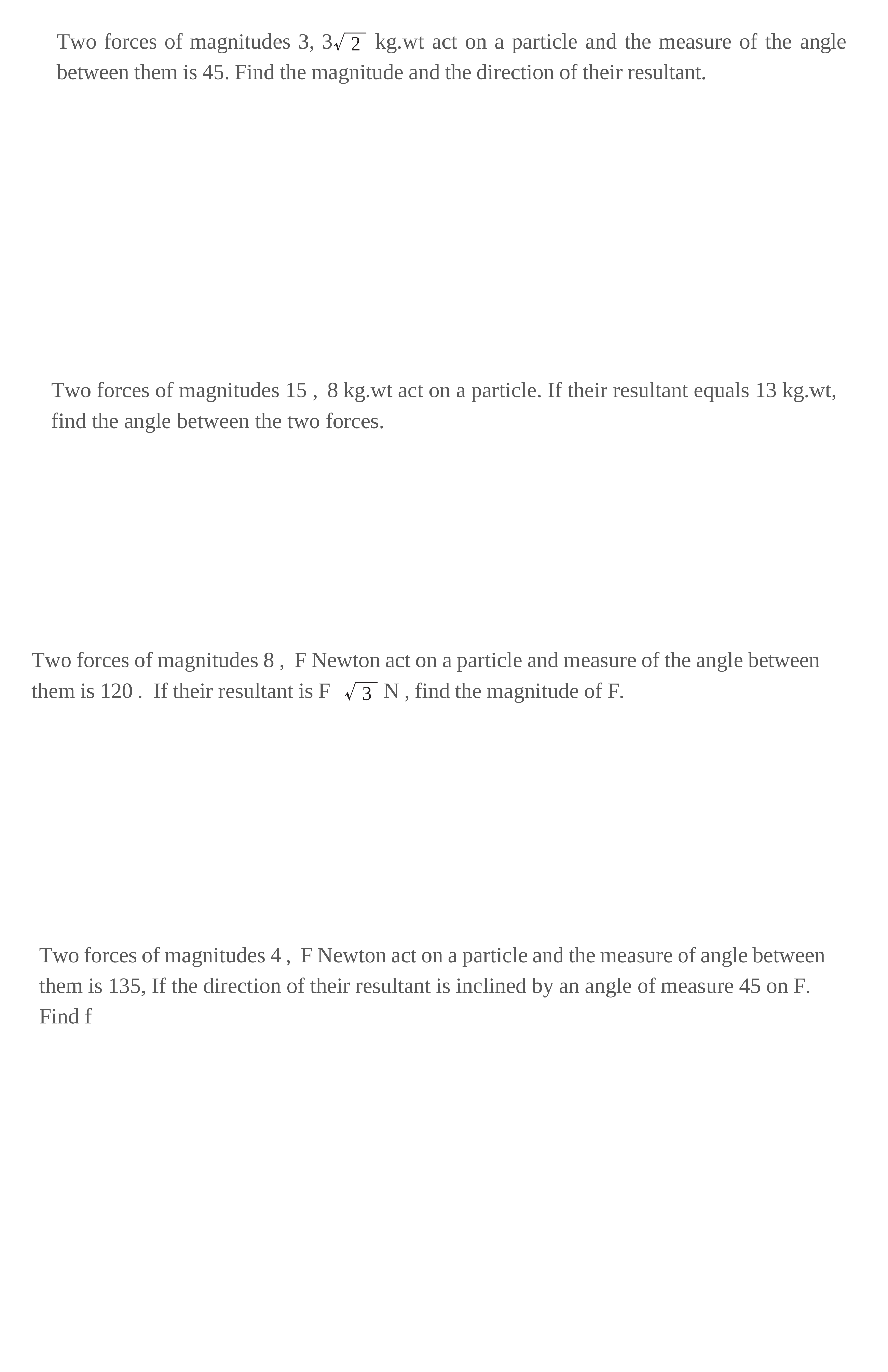
A 1.5   B 3   a $3\sqrt{3}$ D 6

If the two forces 6 , 8 N are perpendicular then the sine of the angle of inclination of their resultant with the first force equals:

A $\frac{3}{5}$ B $\frac{4}{5}$ a $\frac{3}{4}$ D $\frac{4}{3}$

Answer the following questions:

Two forces of magnitudes 5 , 10 Newton act on a particle and the measure of the angle between them is 120. Find the magnitude of their resultant and the measure of the angle made by the resultant with the first force.



Two forces of magnitudes 3, $3\sqrt{2}$ kg.wt act on a particle and the measure of the angle between them is 45. Find the magnitude and the direction of their resultant.

Two forces of magnitudes 15 , 8 kg.wt act on a particle. If their resultant equals 13 kg.wt, find the angle between the two forces.

Two forces of magnitudes 8 , F Newton act on a particle and measure of the angle between them is 120 . If their resultant is F $\sqrt{3}$ N , find the magnitude of F.

Two forces of magnitudes 4 , F Newton act on a particle and the measure of angle between them is 135, If the direction of their resultant is inclined by an angle of measure 45 on F. Find f

Forces resolution

Complete the following:

A force of magnitude 6 Newton acts in direction of North. It is resolved into two perpendicular components, so its component in direction of the East equals .... Newton.

A force of magnitude $4\sqrt{2}$ newton acts in direction of East. It is resolved into two Perpendicular components, so its component in the direction of Northern East equals .... Newton.

If the force $\vec{R}$ is resolved into two components $\vec{F_1}$, $\vec{F_2}$ which make with the force $\vec{R}$ two angles of measures 30, 45 from different directions of its line of action, $\|\vec{R}\| = 12$ newton,

So: F_1 = ... Newton , F_2 =...................... Newton.

If the force $\vec{R}$ is resolved into two components $\vec{F_1}$, $\vec{F_2}$ which make with the force $\vec{R}$ two angles of measure 45, 90 from different directions of its line of action and $\|\vec{R}\| = 18$ Newton, So: F_1 =......... Newton, F_2 =......... Newton

If the force $\vec{F}$ is resolved into two perpendicular components $\vec{F_1}$, $\vec{F_2}$ and the force vector $\vec{F}$ bisects the angle between the directions of $\vec{F_1}$, $\vec{F_2}$ and $\|\vec{F}\| = 6\sqrt{2}$ kg. wt

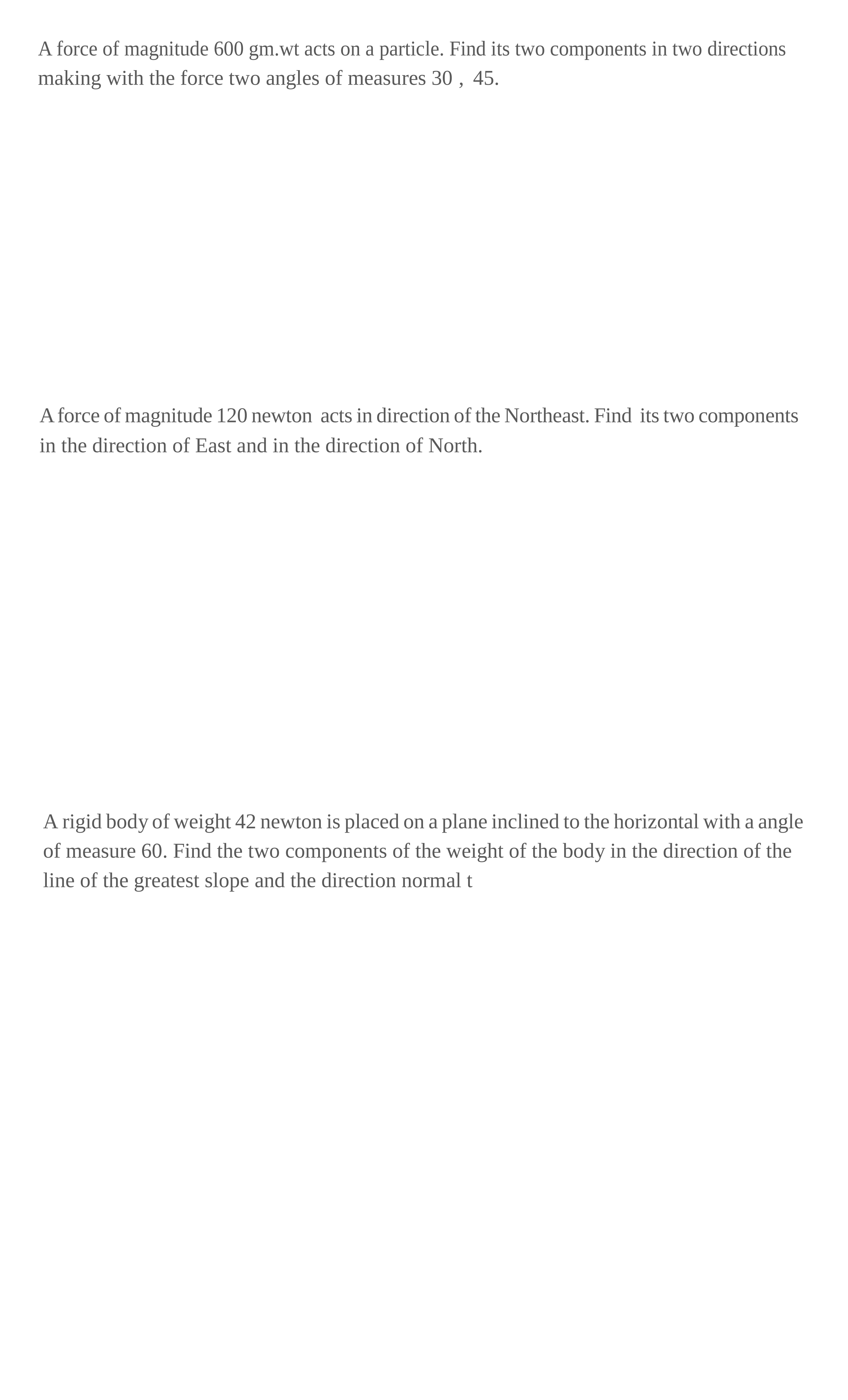
so: $\|\vec{F_1}\|$ = ... kg wt ,

$\|\vec{F_2}\|$ = ...kg wt.

Force of magnitude 12 $\sqrt{2}$ newton acts in direction 30 North of the west.

¾ Magnitude of the component of the force in the western direction = ... Newton.

¾ Magnitude of the component of the force in the northern direction = ... Newton.



A force of magnitude 600 gm.wt acts on a particle. Find its two components in two directions making with the force two angles of measures 30 , 45.

A force of magnitude 120 newton acts in direction of the Northeast. Find its two components in the direction of East and in the direction of North.

A rigid body of weight 42 newton is placed on a plane inclined to the horizontal with a angle of measure 60. Find the two components of the weight of the body in the direction of the line of the greatest slope and the direction normal t

The resultant of coplanar forces meeting at a point



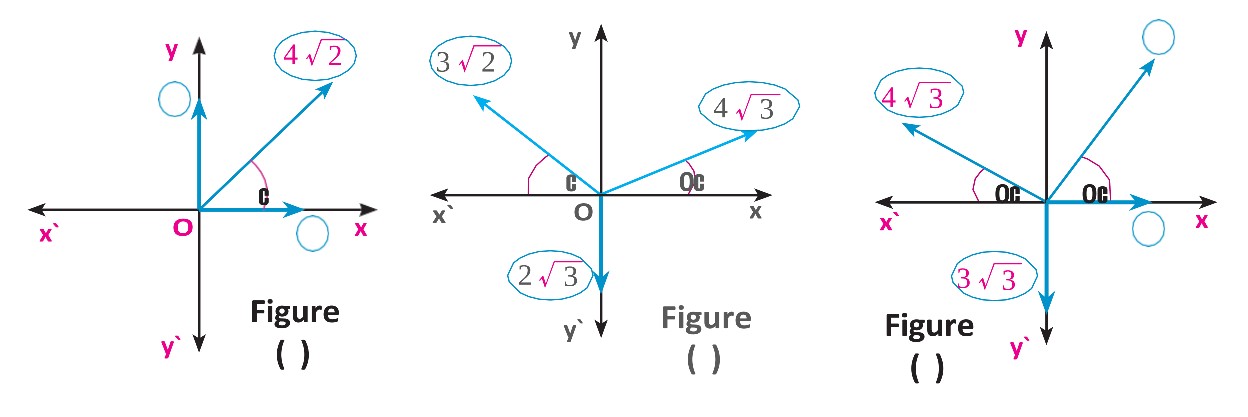
Complete the following:

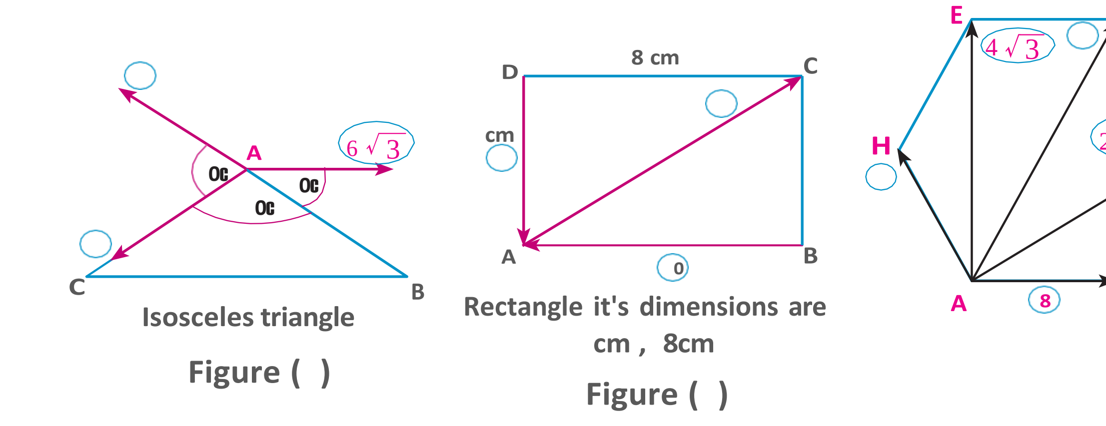
If the forces $F_1 = 2\ i$, $F_2 = i - 2\ j$, $F_3 = 6\ j$ then:
the magnitude of the resultant of the forces = ... and its direction = ...

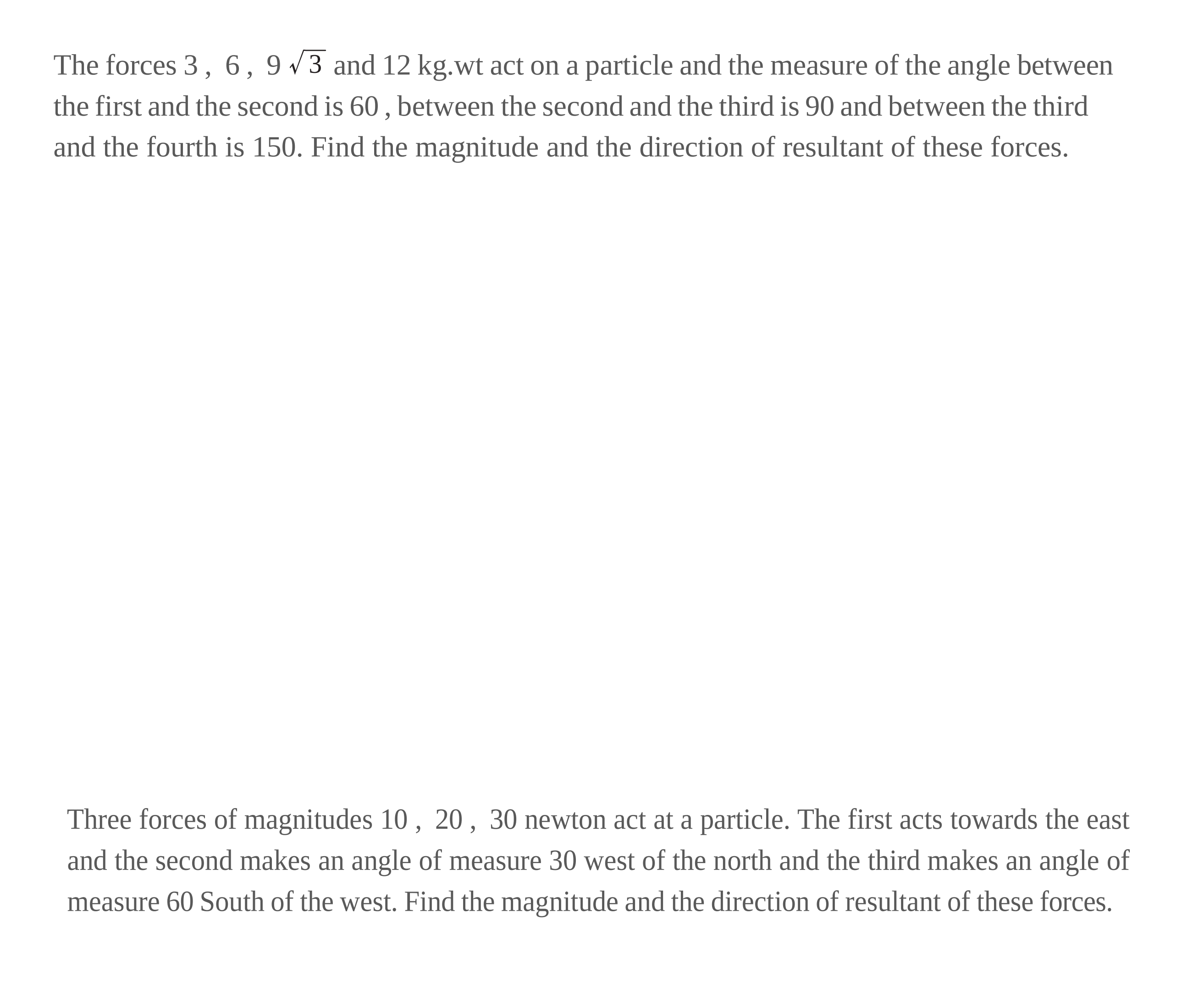
If the forces $F_1 = 2\ i - 2\ j$, $F_2 = 4\ i - 8\ j$, $R = 2a\ i - 3b\ j$
then: a = ... , b = ...

If $F_1 = 3\ i - 2j$, $F_2 = a\ i - j$, $F_3 = 4\ i - bj$, $R = 6\ i - 4\ j$
hen: a = ... , b = ...

Find the magnitude and the direction of resultant of the forces shown in each of the following figures:

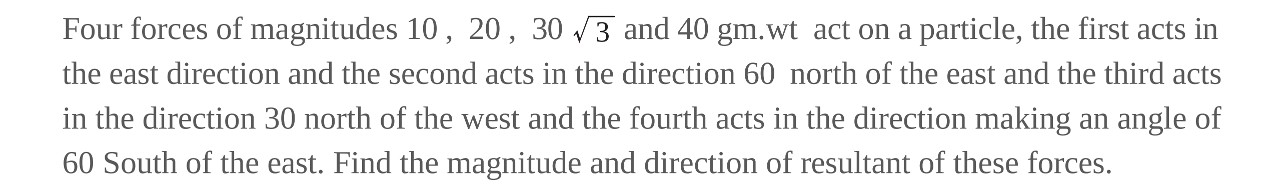






The forces 3 , 6 , $9\sqrt{3}$ and 12 kg.wt act on a particle and the measure of the angle between the first and the second is 60 , between the second and the third is 90 and between the third and the fourth is 150. Find the magnitude and the direction of resultant of these forces.

Three forces of magnitudes 10 , 20 , 30 newton act at a particle. The first acts towards the east and the second makes an angle of measure 30 west of the north and the third makes an angle of measure 60 South of the west. Find the magnitude and the direction of resultant of these forces.

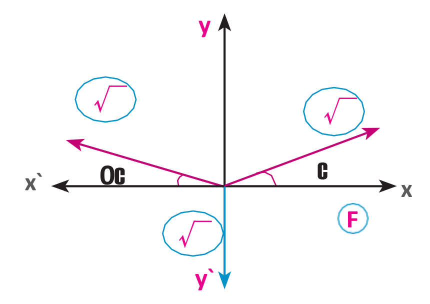

Four forces of magnitudes 10 , 20 , $30\sqrt{3}$ and 40 gm.wt act on a particle, the first acts in the east direction and the second acts in the direction 60 north of the east and the third acts in the direction 30 north of the west and the fourth acts in the direction making an angle of 60 South of the east. Find the magnitude and direction of resultant of these forces.

A B C is an equilateral triangle , M is the point of intersection of its medians. The forces of magnitudes 15 , 20 , 25 newton act on a particle in the directions of $\overrightarrow{MC}$, $\overrightarrow{MB}$, $\overrightarrow{MA}$. Find the magnitude and the direction of the resultant of these forces.

If $F_1 = 5\ i + 3\ j$ ، $F_2 = a\ i + 6\ j$ and $F_3 = 14\ i + b\ j$ are three coplanar forces meeting at a point and their resultant $R = (10\sqrt{2}$ ، $135)$ Find the values of a , b

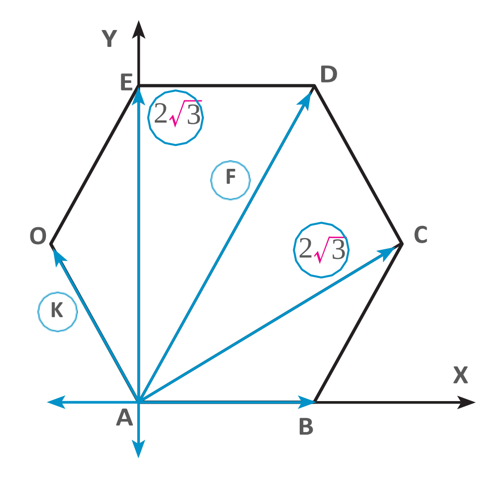
O In the opposite figure :

If the magnitude of the resultant of the forces equals $3\sqrt{2}$ Newton, then find the value of F and the measure of the angle between the line of action of the resultant and the first force



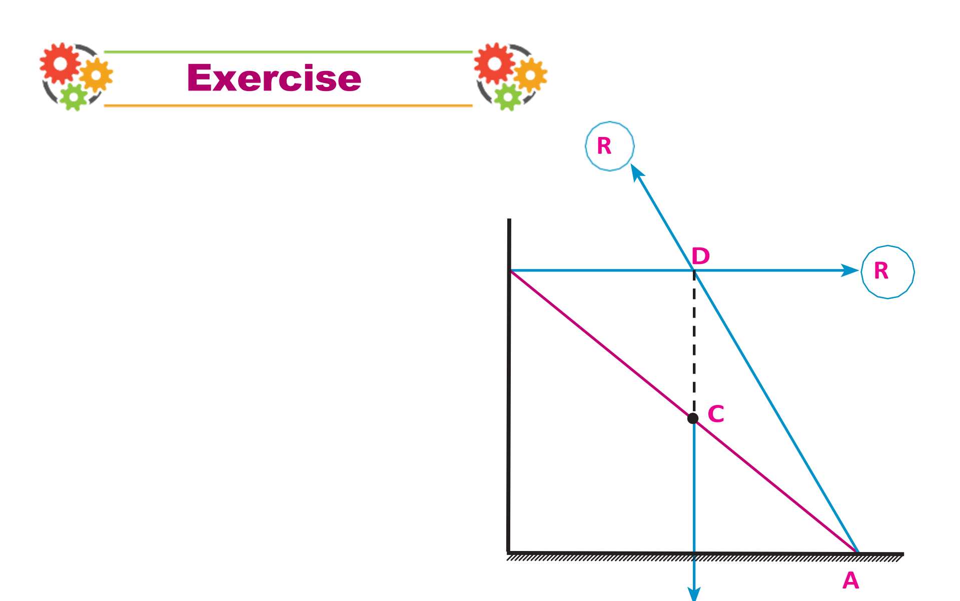
In the opposite figure :

If the magnitude of the resultant of the forces equals 20 Kg.wt and acts in the direction of $\overrightarrow{AD}$ Find the values of F and K.



Equilibrium of a rigid body under the effect of coplanar forces meeting at a point

Exercise



Complete the following:

The necessary and sufficient condition for equilibrium of a set of coplanar forces meeting at a point is to be represented geometrically by ....

The condition for equilibrium of a set of coplanar forces, meeting at a point is to be .... , ...

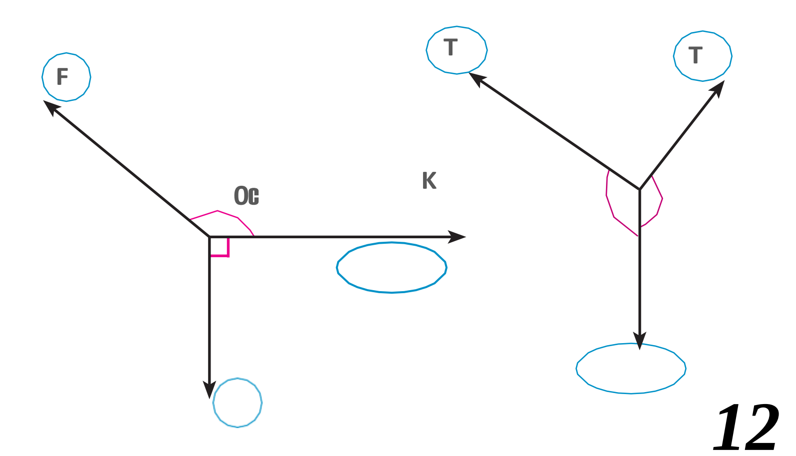
If $\vec{F}_1 = 4\ \vec{i} + b\ \vec{j}$, $\vec{F}_2 = -7\ \vec{i} - 2\ \vec{j}$, $\vec{F}_3 = a\ \vec{i} - 3\ \vec{j}$ are in equilibrium, so:

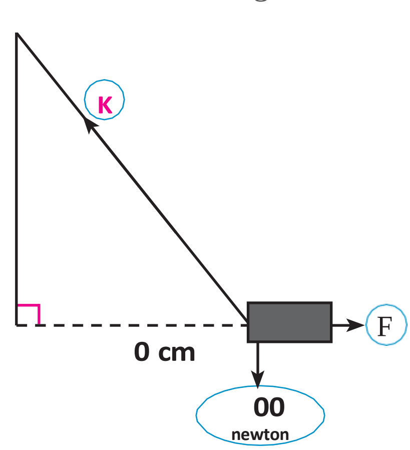
a = ... , b = ...

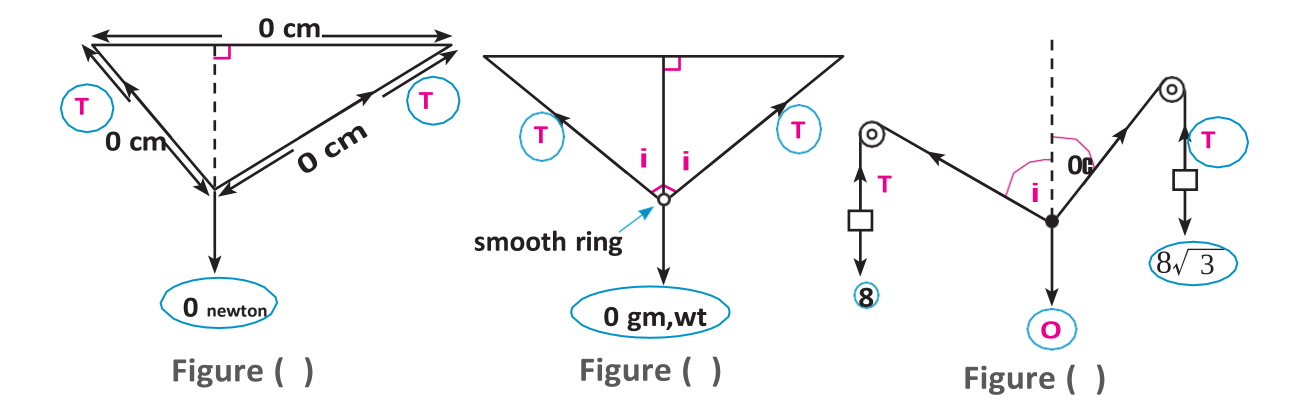
If the force of magnitude F is in equilibrium with two perpendicular forces of magnitude 3, 4 newton so, the magnitude of F = ...

If three coplanar and equilibrium forces are completely represented by the sides of triangle taken in one cyclic order, then the lengths of the sides of the triangle are proportional with .. ..

Each figure from the following figures represents a set of coplanar equilibrium force meeting at a point. Find the value of the unknown either it is a force or a measure of angle .






0 cm
T
0 cm
0 cm
T
0 newton
Figure ( )
T
i
i
T
smooth ring
0 gm,wt
Figure ( )
T
0C
i
T
8
$8\sqrt{3}$
O
Figure ( )

AB is a uniform lader with weight 12 kg.wt rests with its upper end A on a smooth vertical wall and with its lower end B on a rought horizontal ground such that its upper end apart 4m from the ground and its lower end apart 3m from the vertical wall. Find in the case of equilibrium the presure on the wall and the ground

AB is uniform rod with length 60cm and weight 40 Newton connected to a hang on the vertical wall at A. If the rod kept in equilibrium by a light string connected to the rod at B and with point C on the wall just above A and at a distance 60 cm from A. Find the tension on the string and the reaction on the hang at A.

Short answers questions:

Complete the following:

a The scalar quantity to be completely define we need to know ....

b The vector quantity to be completely define we need to know ...., ...

c The directed line segment is the line segment with...................., ..., ...

d Two directed line segments are equivalent if they have ....

e The polar form to the vector $M = 3\ i + 4\ j$ is ....

f The vector that represents the force with magnitude 20 kg.wt in the direction 30 south of east is written as .... ،

In the opposite figure: ABCD is a parallelogram whose diagonals intersected at M:

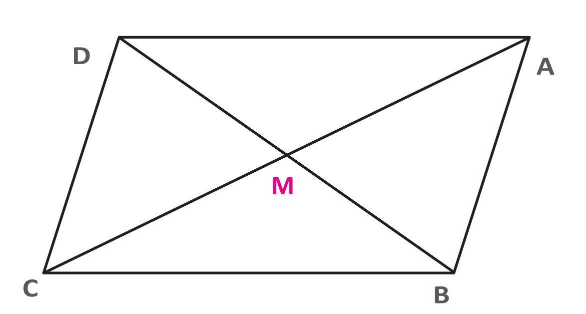
a AB + BC = ...

b DA + DC = ...

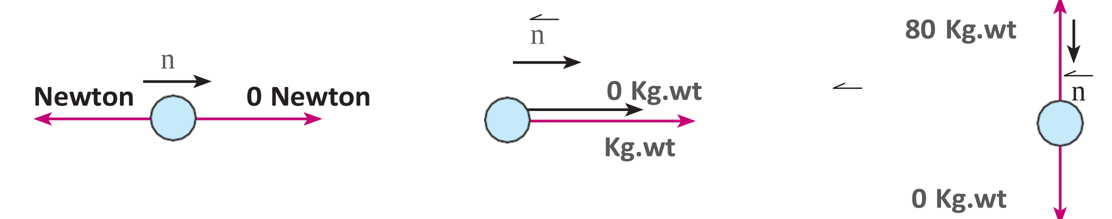
c AM + CM= ....

d AB + 2 BM= ....

e AB - AM = ...



Write in term of the unit vector n the resultant of the forces represented in each figure:



In each of the following forces F_1 ، F_2 act at a particle , determine the direction and the magnitude of the resultant of each of them:

a F_1= 15 Newton acts in the eastern direction, F_2 = 40 Newton acts in the western direction.

b F_1 = 34 gm.wt acts in direction of northern east ، F_2 = 34 gm.wt acts in direction of southern west.

c F_1 =50 Dyne acts in direction of western north F_2 = 50 Dyne acts in direction 30 of the southern east .

d F_1 = 30 Newton acts in direction 20 of the eastern north ، F_1 = 30 Newton acts in Direction 70 of northern east .

$F_1 = 7\ i - 5\ j$ ، $F_2 = a\ i + 3\ j$ ، $F_3 = -4\ i + (b - 3)\ j$

Act at a particle . Find the values of a and b if :

a The resultant of the forces equals $4\ i - 7\ j$

b the forces are equilibrium

Two forces of magnitude $8\sqrt{3}$, 8 newton act at a particle and enclose between them an angle of measure 150. Find the magnitude of their resultant and the measure of the angle which it makes with the first force.

Two forces of magnitude 30 , 16 newton act at a particle, if the magnitude of their resultant is , 26 newton. Find measure of the angle between these two forces.

Two forces of magnitude 2 , F newton and the measure of the angle between them is 120 Find F when:

A Magnitude of the resultant equals F.

B The direction of the resultant is perpendicular to the second force.

C The resultant bisects the angle between the two forces.

Resolve a force of magnitude 60 newton into two forces of equal magnitude and the measure of the angle between their lines of action is 60.

Find the magnitude of the two perpendicular components, to a weight of body placed on horizontal plane if its magnitude = 80 newton if it is known that one of them inclined to the horizontal with angle of measure 30 downwards.

Three forces of magnitudes 2F, 4F , 6F Newton act at a particle in directions parallel to the sides of an equilateral triangle and in the same cyclic order. Find the direction and the magnitude of the resultant.

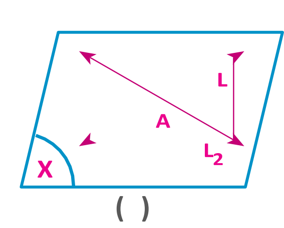
ABCD is a rectangle in which AB = 8cm , BC = 6 cm , E ∈ $\overline{CD}$ in which ED = 6cm forces of magnitude 6, 20, $13\sqrt{3}$, 2 newton act in $\overrightarrow{AB}$, $\overrightarrow{CA}$, $\overrightarrow{AE}$, $\overrightarrow{AD}$ respectively. Find the magnitude and direction of the resultant of these forces.

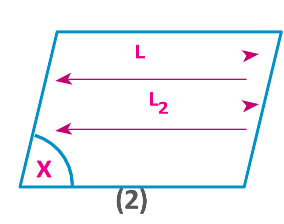
A weight of magnitude 80 gm.wt is suspended by a string fixed in a vertical wall. if the weight is pulled by a force perpendicular to the string till it becomes in a position inclined on the wall by an angle of measure 30. Find the magnitude of the force and the tension in the string in the state of equilibrium.

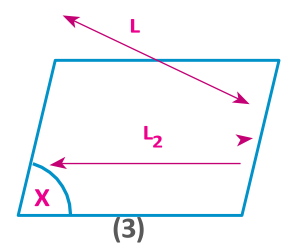
A uniform rod rests with its ends on two smooth planes inclined to the horizontal by two angles of measure 60, 30. Find the measure of the angle that the rod makes with the horizontal in the equilibrium state, If the magnitude of weight of the rod equals 24 newton, Find the magnitude of the reaction for each of the two plan

The relation between two straight lines in the space:

Meditate the following figures, and then complete:







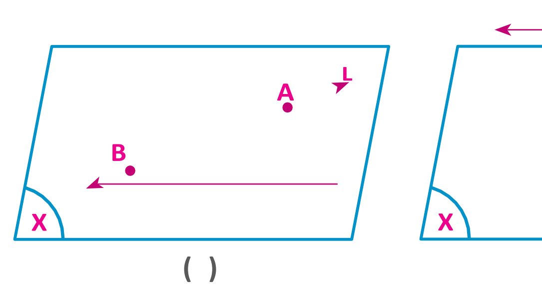
1- The two intersected straight lines: are two straight lines lie in the same …….and having a common …………………… .

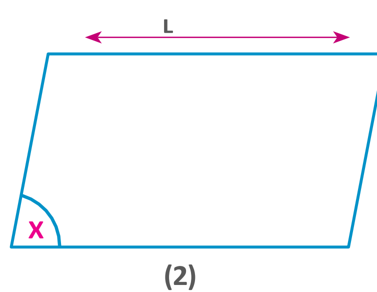
2- The two parallel straight lines: are two straight lines lie in the same .... and does not have a common …………………… .

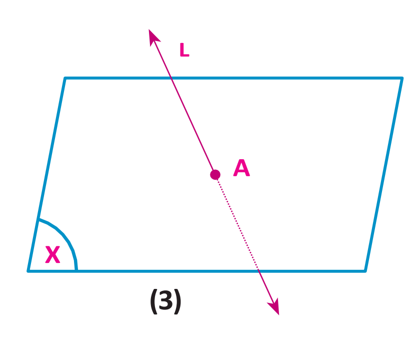
3- The two skew straight lines: are two straight lines does not contained in the same …………….. and they are not ……………………

The relation between a straight line and a plane in the space:

Meditate the following figures, and then complete:







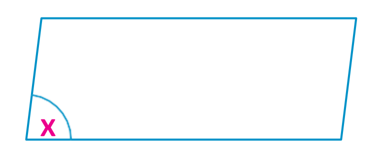
¾ The straight line is parallel to the plane in figure ……………………

¾ The straight line is intersected with the plane in figure ……………………

¾ The straight line contained in the plane in figure ……………………

The relation between two planes in the space:

Meditate the following figures, and then complete:



Exercise

Complete the following:

If the straight line L // the plane X, then L ∩ X = ...

If the straight line L ⊂ the plane X, then L ∩ X = ...

If the straight line L_1 // the straight line L_2 ,then $L_1 \cap L_2$ = ...

If X and Y are two planes such that: X ∩ Y = Z, then X .... Y

The two skew straight lines are neither …….. nor ………

State the number of planes that passes through the following:

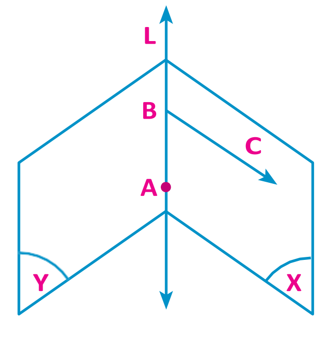
a One given point

b Two different points

c Three collinear points

d Three non-collinear points.

e Four non-coplanar points



Meditate the following figure, and then complete using one of the following symbols (∈ , ∉ , ⊂ , ⊄)

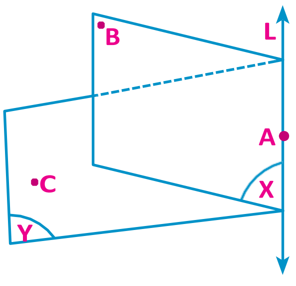
a L X

b A........ X

c C .... Y

d $\overleftrightarrow{BC}$........... Y

In the opposite figure : X,Y are two planes intersected at the straight line L ,A ∈ L ,B ∈ X, B ∉ Y, C ∈ Y, C ∉ X Complete the following:





a The plane X ∩ The plane A B C = ...

b The plane Y ∩ The plane A B C = ...

c The plane X ∩ The plane Y ∩ The plane A B C = ...

Meditate the following figure, and then complete the following:

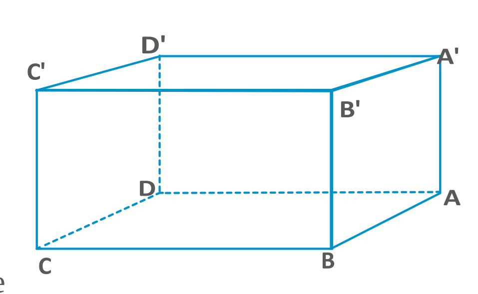
a The plane ABCD // The plane ....

b The plane BCC'B' // The plane ....

c The plane ABB'A' ∩ The plane ABCD = ...

d The plane ABB'A' ∩ The plane DCC'D'= ....

e The plane DCC'D' ∩ The plane A B C D ∩ The plane ADD'A'= ....



Put the sign (�) for the correct answer and the sign (�) for the incorrect answer where L_1 ، and L_2 are two straight lines and X,Y are two planes:

a If $L_1 \cap L_2 = z$ **then** $L_1 // L_2$ **or** L_1 , L_2 are skew

b If $L_1 \cap X = z$ **then** $L_1 // X$

c If $L_2 \cap X = L_2$ **then** $L_2 \subset X$

d If $L_2 \subset Y$ **then** $L_2 \cap Y = z$

e If $X \cap Y = z$ **then** $X // Y$

f If X = Y **then** X ، Y are coincident

Choose the correct answer for each of the following:

Any four non-coplanar points form :

a Two planes   b three planes   c four planes   d no plane

If two plane have two common points A and B, then they will be:

a Coincident

b intersected at $\overleftrightarrow{AB}$

c Intersected at a straight line parallel to $\overleftrightarrow{AB}$

d With a third common point does not belong to $\overleftrightarrow{AB}$

$\overleftrightarrow{AB}$ // the plane X if

a $\overline{AB} \cap X = z$

b A and B lie in two different sides from X

c A and B with two different distances from X

d $\overleftrightarrow{AB} \cap X = z$

The two straight lines L_1 and L_2 are parallel if:

a $L_1 \cap L_2 = z$

b $L_1 \cup L_2$ lie in the same plane

c $L_1 \cap L_2 = z$, L_1 , L_2 located in the same plane.

d $L_1 \cap L_2 = z$, L_1 , L_2 does not located in the same plane.

The two straight lines are skew, if they are:

a not parallel.

b not coincident.

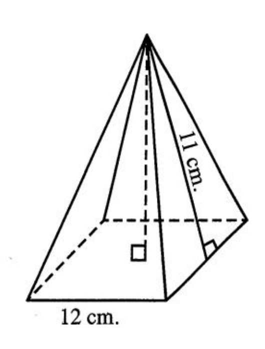
c not located in the same plane.

d located in the same

Exercises

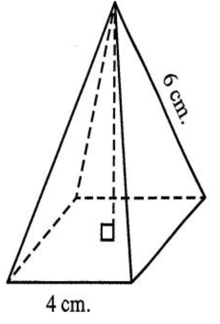
(1) **The opposite figure :**

Represents a regular quadrilateral pyramid of height = ... cm.



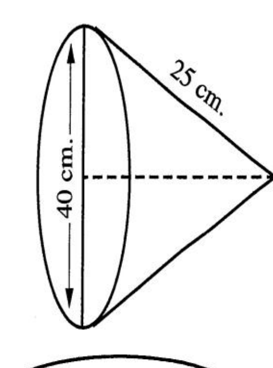
(2) **The opposite figure :**

Represents a regular quadrilateral pyramid of height = ... cm.



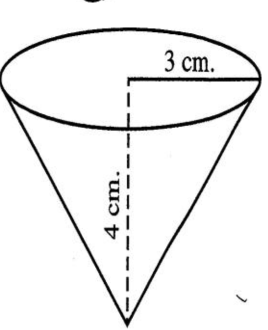
(3) **In the opposite figure :**

The height of the cone = ... cm.



(4) **In the opposite figure :**

The length of the drawer = ... cm.



(5) MABCD is a regular quadrilateral pyramid , its base as a square ABCD , if its height equals $4\sqrt{3}$ cm. , and its edge length MA = $4\sqrt{5}$ cm. , find the length of its base side.

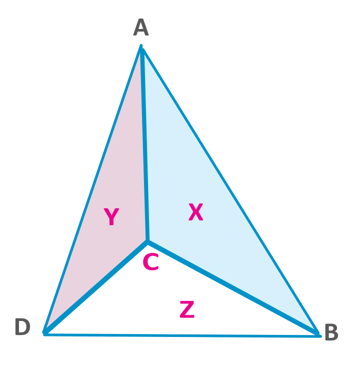
(6) MABCD is a regular quadrilateral pyramid whose base as a square ABCD of side length 16 cm. , if the length of its lateral edge equals the side length of its base.

Find the height of the pyramid.

(7) A right circular cone , the length of its drawer equals 17 cm. and its height equals 15 cm. Find the length of the radius of its circle.

Exercises

The opposite figure represents a triangular pyramid, X , Y and Z are three planes. Complete the following



A $X \cap Y =$ .... **B** $X \cap Z =$ ....

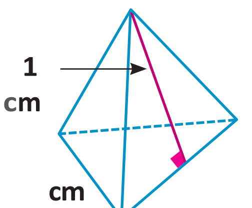
C $Y \cap Z =$ .... **D** $\overleftrightarrow{AB} \cap X =$ ....

E $\overleftrightarrow{BC}$ $\cap$...................... X , $\overleftrightarrow{BC}$.................. Z

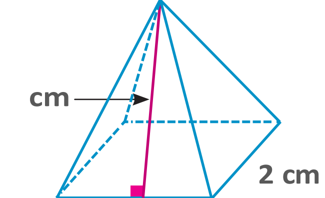
F $X \cap Y \cap Z =$ ....

Find lateral area, and total area for each regular pyramid, according to the given data

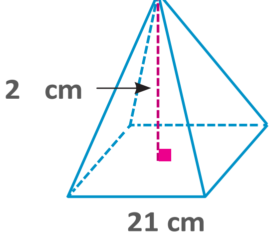
A



B

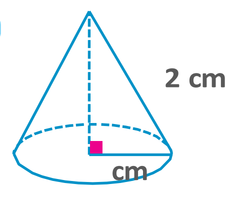


C

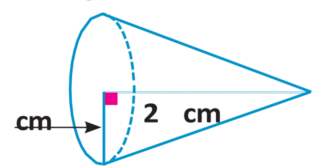


3 Find lateral area, and total area for each right cone, according to the given data.

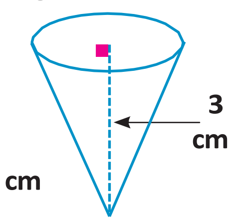
A



B

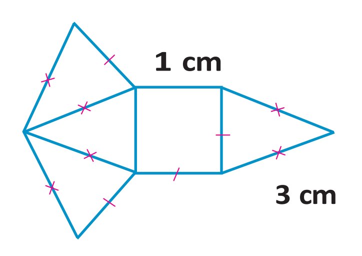


C



Hexagonal regular pyramid, the length of its base side 12 cm and its slant height $10\sqrt{3}$ cm. Find:

A Its lateral area **B** Its total area



Connecting to industry: products containers of a factory manufactured from cardboard by folding the net of the opposite figure.

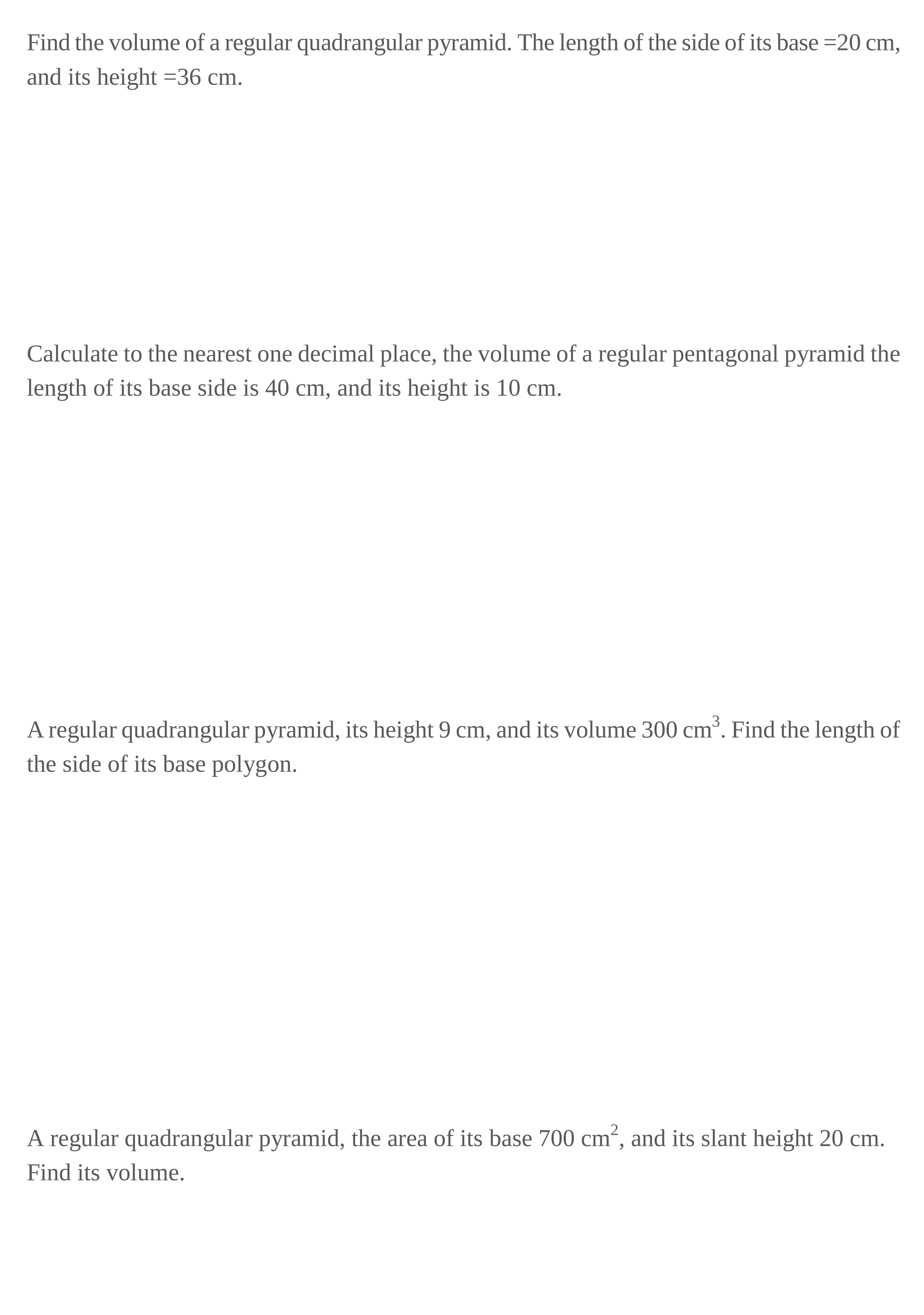
A Find the area of the used cardboard to produce 1000 container.

B Calculate the costs of the used cardboard if each square meter costs 15 pound.

A piece of cardboard is folded in the form of circular sector the length of its radius 36 cm and the measure of its angle 210c for making a right circular cone has the greatest area. Find the height of the cone.

(The area of the sector = $\frac{1}{2}$ r^2 i^{rad}, r radius of circular sector, i^{rad} is the measure of the angle in radian)

Find the length of the radius of a right cone, if the length of the cone drawer 15 cm and its total area 154 r cm^2.



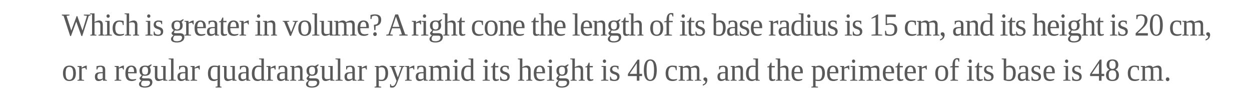
Exercises

Find the volume of a regular quadrangular pyramid. The length of the side of its base =20 cm, and its height =36 cm.

Calculate to the nearest one decimal place, the volume of a regular pentagonal pyramid the length of its base side is 40 cm, and its height is 10 cm.

A regular quadrangular pyramid, its height 9 cm, and its volume 300 cm^3. Find the length of the side of its base polygon.

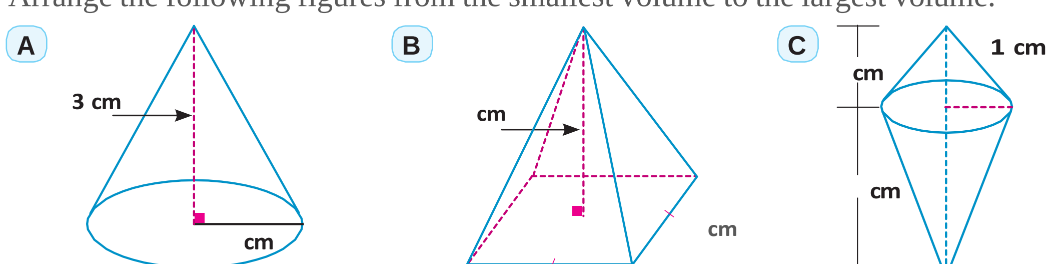
A regular quadrangular pyramid, the area of its base 700 cm^2, and its slant height 20 cm. Find its volume.


Which is greater in volume? A right cone the length of its base radius is 15 cm, and its height is 20 cm, or a regular quadrangular pyramid its height is 40 cm, and the perimeter of its base is 48 cm.

Find the volume of a right cone its base perimeter is 44 cm, and its height is 25 cm.

Find the volume of a right cone its lateral area is 220 cm^2, and the length of its drawer is 14 cm.

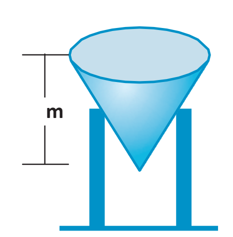
Arrange the following figures from the smallest volume to the largest volume.



Connecting to tourism : A model of the great pyramid is made of metallic alloy its density is 3.2 gm/cm^3. If the length of the model side base 11.5 cm, and its height 7 cm, then calculate its mass to the nearest one decimal place.

Connecting to physics: A cylindrical shaped vessel contain water, A metal body in the form of a right cone, its height is 12cm, and the length of its base radius is 2 cm and is completely immersed in it Raising the surface of the water in the vessel with the value 1 cm. Find the length of base diameter of the vessel.

Civil engineering: A tank of water in the form of right cone, its volume is 32 ɼm^3 and its height is 6 m. Find the length of its base radius and its total area.



Exercises

Choose the correct answer from those given:

The point (2 , 0) lies on the:

A x - axis
B y - axis
C straight line y= 2x
D circle $x^2 + y^2 = 9$

If A(3 , -7) , B(-3 , 5) , then the coordinates of the midpoint of $\overline{AB}$ is ....

A (0 , 1)
B (1 , 0)
C (0 , -1)
D (-1 , 0)

The distance between the two points (2 , 4) , (10 , -2) equal .....

A 9
B 10
C $3\sqrt{10}$
D 6

The circle $x^2 + y^2 = 25$ its center (0 , 0) and passes through the point ....

A (1 , 4)
B (5 , 0)
C (25 , 0)
D (5 , 1)

The equation of a circle whose center (3 , -5) and the length of its radius equal 7 units is:

A $(x - 3)^2 + (y - 5)^2 = 49$
B $(x + 3)^2 + (y + 5)^2 = 49$
C $(x + 3)^2 + (y - 5)^2 = 49$
D $(x - 3)^2 + (y + 5)^2 = 49$

The circumference of the circle whose equation $x^2 + y^2 = 8$ equals:

A 8 r
B 64 r
C $2\sqrt{2}$ r
D $4\sqrt{2}$ r

Write the equation of a circle whose center M, and the length of its radius r where:

A M (2, 3) , r = 5

B M(0 , 0) , r = 4

C M (3, 0) , r = 6

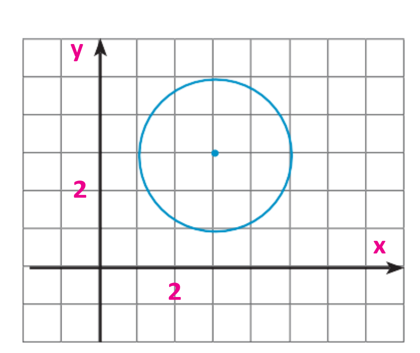
D M(4 , -5) , r = $\sqrt{7}$

E M (0, -1) , r = $2\sqrt{3}$

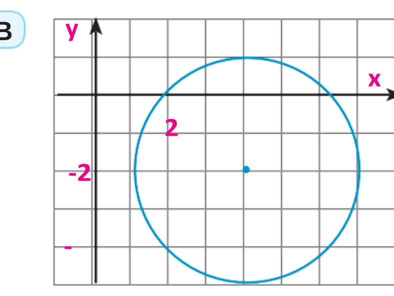
F M(-4 , -3) , r = $\frac{3}{2}$

Write the equation of a circle represented by the given figure:

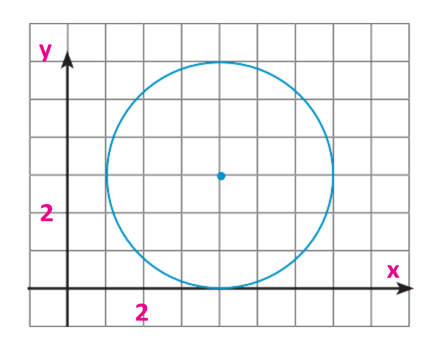
A



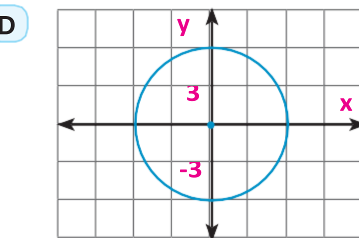
B



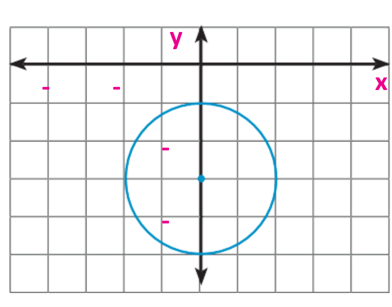
C



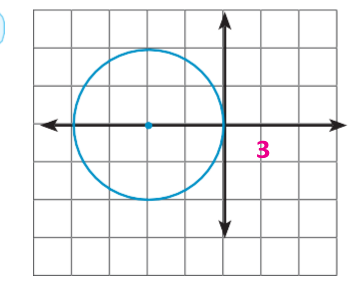
D



E



F



Find the equation of a circle if:

A Its center M (7 , -5), and it passes through the point A(3 , 2).

B $\overline{AB}$ is a diameter in the circle, where A(6 , -4) , B(0 , 2).

C Its center is the point (5 , -3) and touches the x-axis

Find the center, and the length of the radius for each of the following circles:

A $x^2 + y^2 = 27$

B $(x + 3)^2 + (y - 5)^2 = 49$

C $(x - 2)^2 + y^2 = 16$

D $x^2 + (y + 7)^2 = 24$

Write the general form of the equation of a circle in the following cases:

A Its center M(3 , 1) ,and the length of its diameter equal 8.

B Its center M (0 , 0), and it passes through the point A (-1 , 3)

C Its center M (-5 , 0), and it passes through the point B (3 , 4)

D $\overline{AB}$ is a diameter in it, where A(3 , -7) , B(5 , 1)

Find the center, and the length of the radius for each of the following circles:

A $x^2 + y^2 - 4x + 6y - 12 = 0$

B $x^2 + y^2 + 2x = 8$

C $x^2 + y^2 - 6x + 10y = 0$

D $x^2 + y^2 - 8x = 12$

Show which of the following circles are congruent:

A $x^2 + y^2 - 2x + 4y - 3 = 0$, $x^2 + y^2 + 6x - 11 = 0$

B $x^2 + y^2 - 14x + 37 = 0$, $x^2 + y^2 + 10x + 13 = 0$

Show which of the following equation is for a circle, then find its center and the length of its radius:

A $x^2 + y^2 + 8x - 16y - 1 = 0$

B $x^2 + 2y^2 + 6x - 5y = 0$

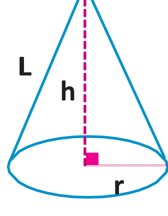
C $\frac{1}{4}x^2 + \frac{1}{4}y^2 + x - 8 = 0$

D $x^2 + y^2 + 2xy - 12 = 0$

E $x^2 + y^2 - 2x + 4y + 7 = 0$

F $2x^2 + 2y^2 + 3y - 8 = 0$

Choose the correct answer:



All the following cases determine a plane except:

A) A straight line and a point does not belong to it.
B) Two parallel straight lines and not coincident.
C) Two intersected straight lines.
D) Two skew straight lines.

The total area for the right cone equal:

A) rrL
B) $\frac{r}{3}$ r^2h
C) rr (r + L)
D) $\frac{r}{3}$ r (rh + 3L)

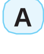
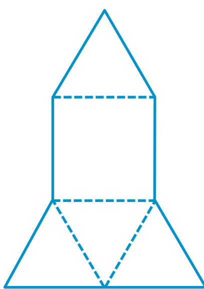
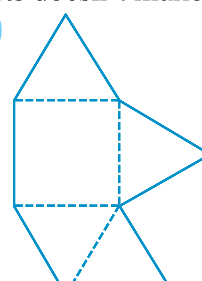
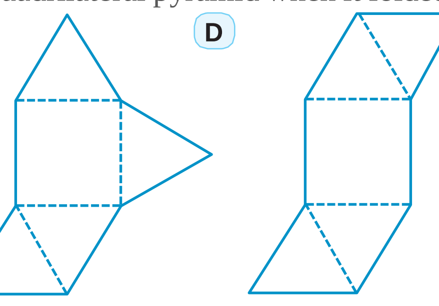
A regular quadrangular pyramid, the perimeter of its base 36 cm, and its height 10 cm, then its volume equals.............cm^2

A) 810
B) 180
C) 360
D) 270

The center of the circle : $(x + 2)^2 + y^2 + 2y = 0$, is the point:

A) (2 , 2)
B) (-2 , -1)
C) (2 , -1)
D) (-4 , 2)

Which of the following nets doesn't make a regular quadrilateral pyramid when it folded?


A

B

C D


Questions with short answer

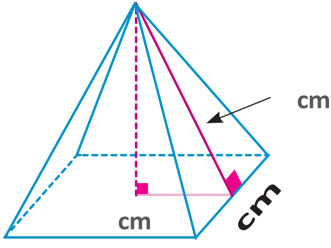
How many straight lines can be drawn in each of the following cases:

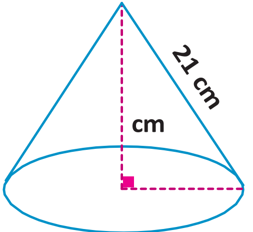
A) Passes through two different points.
B) Passes through three non-collinear points.
C) Passes through two intersected planes.
D) Passes through four points in the space, each three points from them are non-collinear.

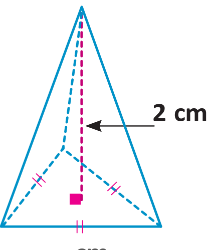
How many planes can be drawn passing through each of the following?

A) A point
B) Two determine points
C) Three non-collinear points

8 Find the volume of each of the following solids to the nearest cm^3.

A


B


C


Find the equation of a circle, its center is the point (2 , -7) and its passes through the point (1 , 3).

Which of the following circles are congruent? Explain your answer.

A) $x^2 + y^2 + 4x - 2y - 5 = 0$, $x^2 + y^2 + 6x - 4 = 0$
B) $x^2 + y^2 - 4x + 8y = 0$, $x^2 + y^2 + 12y + 16 = 0$

Questions with long answer:

Calculate to the nearest tenth, the volume of a regular pentagonal pyramid if the length of its polygon base side =16 cm and its height =12 cm